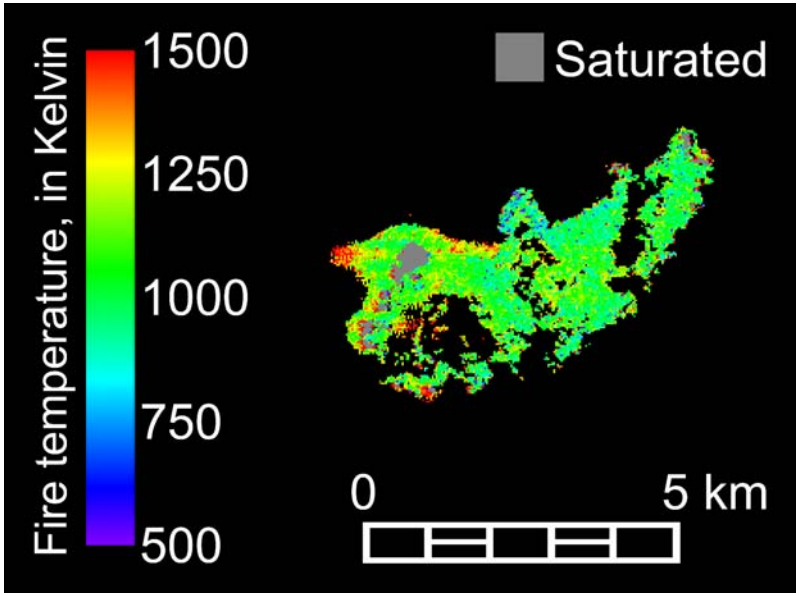
CQ2a: How does the timing, temperature and frequency of fires affect long-term ecosystem health?



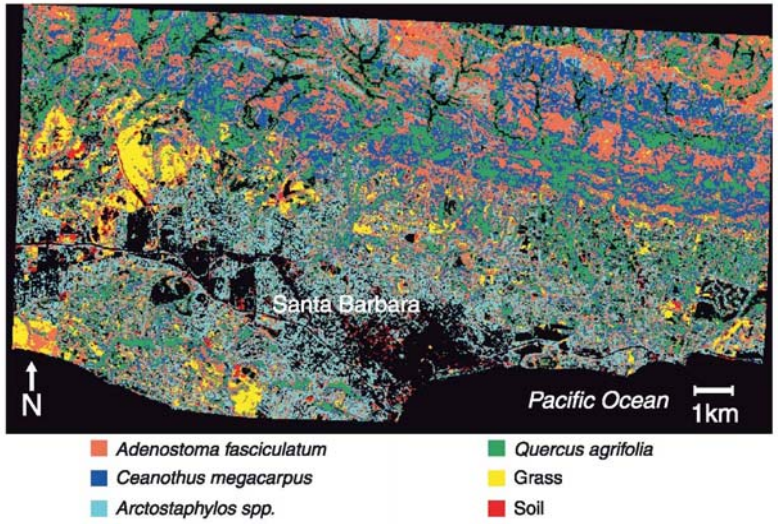
Fire temperature retrieved from ASTER SWIR bands for the July 2007 Sawmill fire. (Eckman et al., 2009, in review for IJRS)

Fires can have significant impacts on ecosystem health
(http://www.pfc.cfs.nrcan.gc.ca/entomology/mpb/management/fire/images/tsacfire_lrg.jpg)

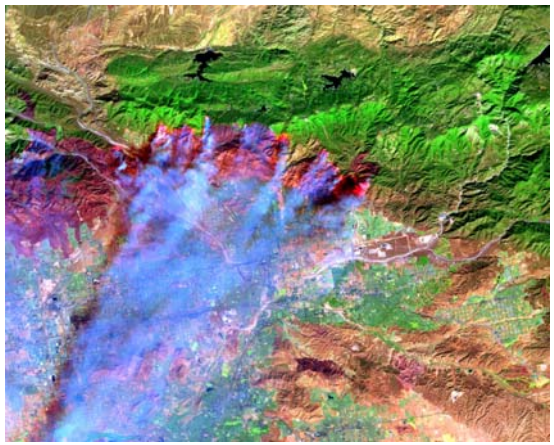
- Science issue
  The state of an ecosystem can be affected by changes in fire regime. Changes in both fire occurrence (both timing and frequency) and fire temperature can have long-term impacts on the state of the vegetation and the entire ecosystem.
- Tools
  Requires long-term, accurate, fire detection, fire monitoring, and mapping of fire intensity. HyspIRI TIR data are required to accurately map small and smoldering fires as small as 10 sqm in size.
  Further requires pre- and post-fire assessment of ecosystem health, which can be performed in part using HyspIRI VSWIR imagery.
  Requires possibly historical data from other sensor to supplement the temporal coverage of the HyspIRI data.
- Approach
  Use HyspIRI TIR data (and possibly data from other sensors) to map fire occurrence, temperature and frequency. This data can then be analyzed in conjunction with information on ecosystem health acquired from HyspIRI VSWIR data.

CQ2b: How does vegetation composition and fire temperature impact trace gas emissions?

Hyperspectral VSWIR data allows for highly accurate and very detailed mapping of fuel type as shown here by an example for AVIRIS. Classfication accuracy: 89%. (Dennison and Roberts, 2003)



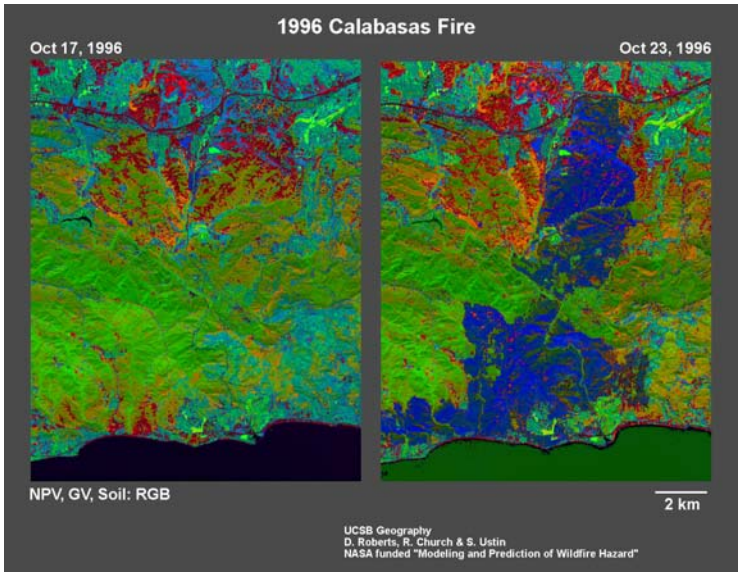
High-resolution imagery of fires is very valuable for modeling composition and behavior emissions as shown here by an ASTER image of the Grand Prix Fire



- Science issue
  Fires burn in a wide variety of vegetation types that differ in fuel type, fuel load, fuel condition etc. It is likely that the state of the vegetation does not only affect the behavior and severity of the fire but also affects the quantity and composition of emitted trace gases.
- Tools
  Requires hyperspectral HyspIRI VSWIR data to accurately characterize vegetation composition, including fuel type, fuel load, and fuel condition. Further requires HyspIRI TIR data to map fire temperature and fire extent.
- Approach
  Vegetation composition mapped using HyspIRI VSWIR data can be used in conjunction with fire temperatures to model trace gas emission of individual fires. Trace gases can also be mapped using VSWIR data. Validation can be carried out against other sources of information on trace gases in the atmosphere.

CQ2c: How do fires in coastal biomes affect terrestrial biogeochemical fluxes into estuarine and coastal waters and what is the subsequent biological response? [DS 198]

Mapping of fuel condition using Spectral Mixture Analysis for the 1996 Calabasas fire, which burned all the way to the ocean



The 2008 Gap fire in Goleta, CA, provides another example for a fire occuring in a coastal biome with potential effects on the coastal waters (from http://www.nasa.gov/images/content/258987main_ikhanafire1_HI.jpg)

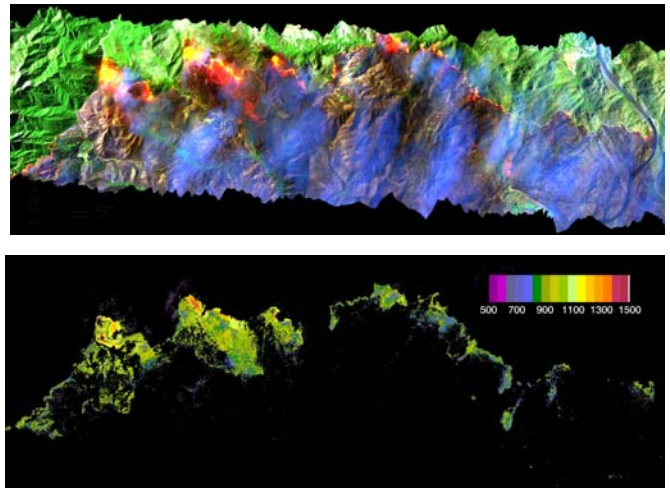
- Science Issue
  Fires do not only burn inland but can also occur in coastal biomes. Such fires and their associated biogeochemical fluxes into nearby waters can cause changes in water characteristics.

- Tools
  Requires HyspIRI TIR data to detect occurrence of fires in coastal biomes and to further map their extent and intensity.
  Requires HyspIRI VSWIR data over coastal waters to assess impacts of biogeochemical fluxes such as changes in water clarity.
  Further requires additional information on biological response.

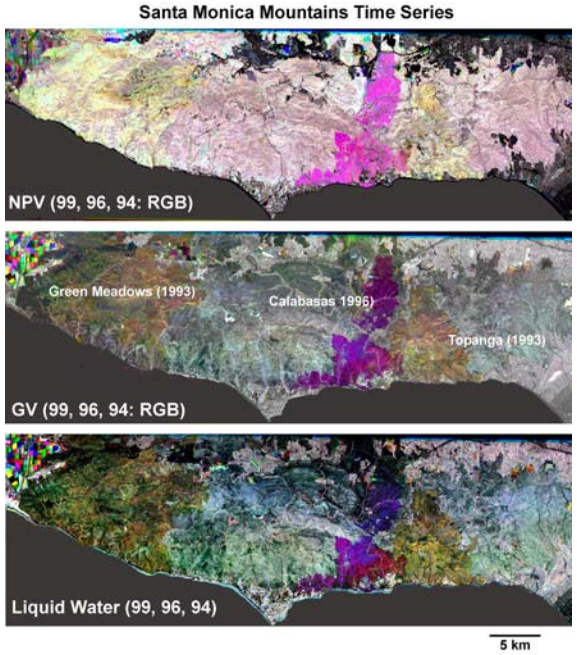
- Approach
  Use HyspIRI TIR data to detect and map fires in coastal biomes. Use HyspIRI VSWIR data to observe subsequent changes in water clarity and productivity. Use additional biological data to further explain and

CQ2d: What are the feedbacks between fire temperature and frequency and vegetation composition and recovery?

Fire temperature retrieval from AVIRIS imagery (Dennison et al. 2006)



Post-fire response to three different fires, two in 1993 and one in 1996. Canopy moisture is the most sensitive measure of change, as shown by overlap between the 1996 and 1993 Calabasas and Topanga fires. High fire return intervals in Southern California are impacting ecosystems, eliminating some shrub species. (Dar Roberts)



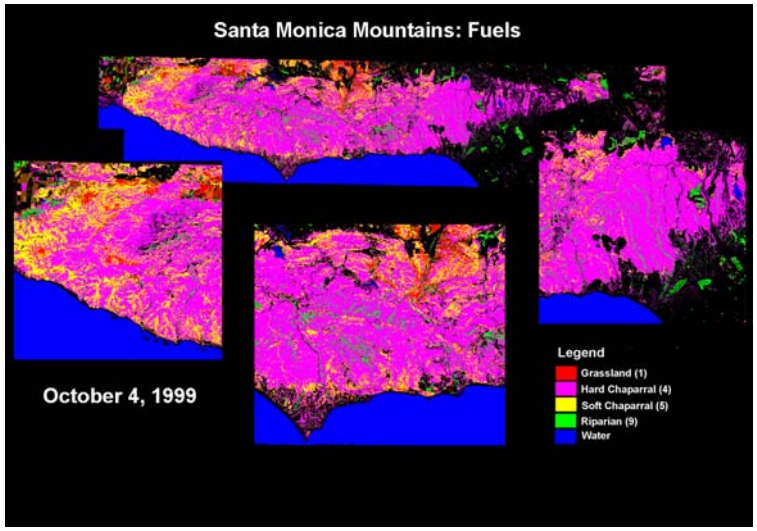
- Science Issue
  The intensity of fires and their frequency are likely to have effects on postfire succession of vegetation. For example, frequent, low intensity fires might produce a type of conversion from shrubland to grassland.

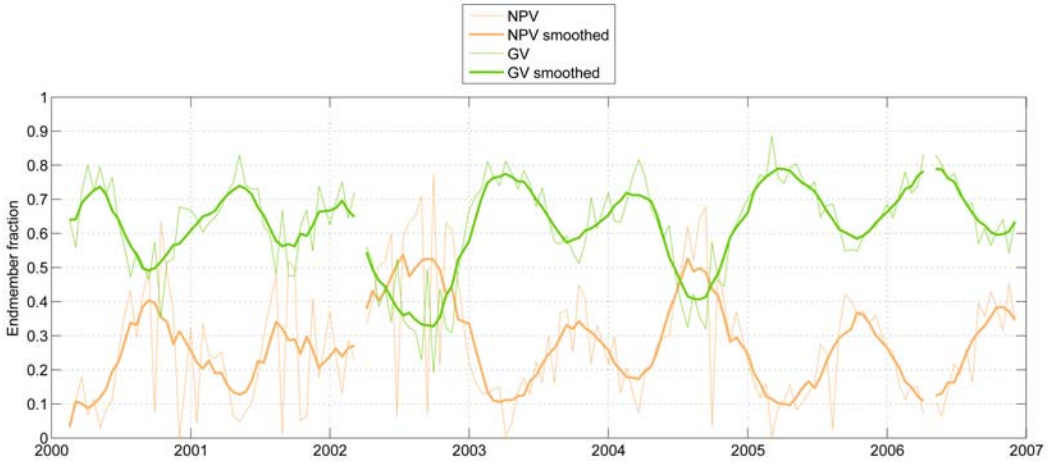
- Tools
  Requires HyspIRI TIR data to determine frequency of fires on a larger scale and temperature of indivual fires on a smaller scale. Further requires time series HyspIRI VSWIR imagery for long-term mapping and observation of vegetation composition and recovery after fires.

- Approach
  Use HyspIRI TIR data to detect fires and their frequency. Use the same data to map fire temperature and thus burn intensity. Use HyspIRI VSWIR pre-fire data to establish a baseline of vegetation composition, and use HyspIRI VSWIR post-fire data to monitor succession and post-fire

CQ2e: How does vegetation composition influence wildfire severity?

Fuels can be accurately mapped using hyperspectral imagery as shown here for the example of AVIRIS (provided by Phil Dennison)

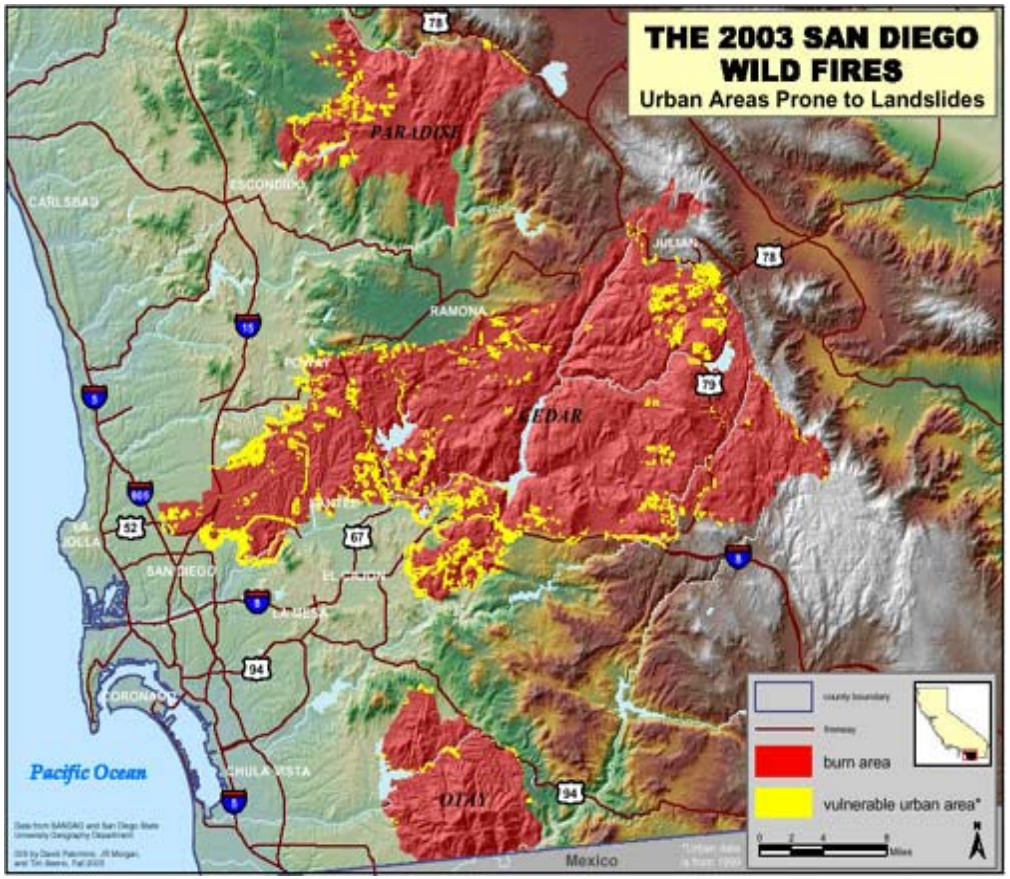




Time series of fuel condition (fractions of Non-Photosynthetic vegetation and Green Vegetation) derived from MODIS using Multiple Endmember Spectral Mixture Analysis. Such measures can be used to evaluate the recovery of vegetation after fire (Schneider, 2008)

- Science Issue
  Vegetation composition, i.e. fuel type and fuel condition (the fractions of live and dead vegetation) affect fire temperature and fire behavior. In addition to images during the fire, quantifying the impact of vegetation composition on fire severity requires samples from a large number of fires.
- Tools
  Requires HyspIRI VSWIR data to determine vegetation composition pre- and post-fire. Further requires HyspIRI TIR imagery during the fire for estimating wildfire severity.
- Approach
  Gather TIR data from active fires and relate fire temperature as a proxy of fire severity to a wide variety of pre-fire vegetation states acquired from VSWIR data as a baseline. Vegetation states should include a wide variety of fuel types,

CQ2f: On a watershed scale, what is the relationship of vegetation cover, clay-rich soils and slope, to frequency of debris flows?



Analysis of landslide potential after the 2003 San Diego fires (Palomino et al., 2003)

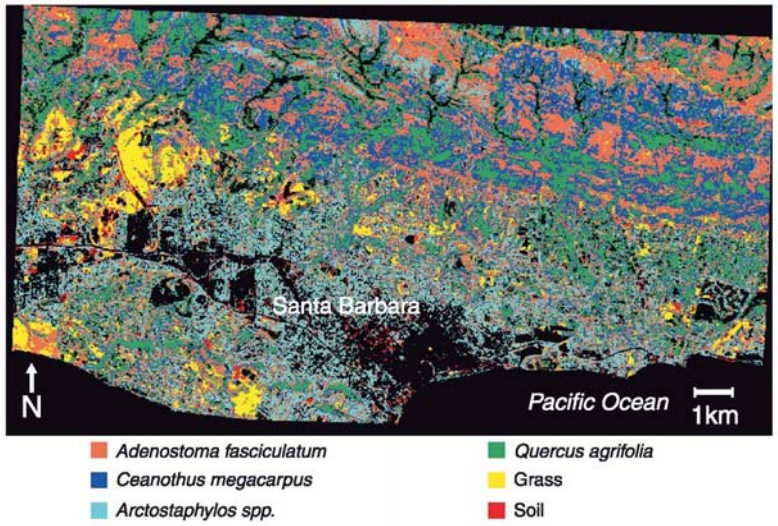
- Science Issue
  Landslides are a common occurrence in recently burned areas. However, they occur a varying frequencies. It is likely that a combination of parameters such as vegetation, soils, and/or terrain affect the frequency of debris flows.

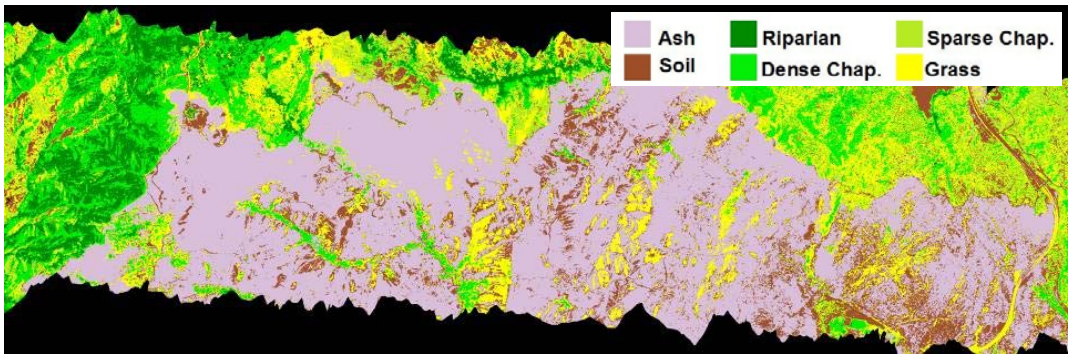
- Tools
  Requires HyspIRI TIR data for identifying areas of variable fire frequency. Further requires post-fire HyspIRI VSWIR data for determining vegetation cover. Use a combination of both data sets for identifying areas of clay-rich soils. Requires DEM as additional information to derive slope. Further use VSWIR data to map debris flows in affected areas.

- Approach
  Identify possible study sites using a combination of HyspIRI VSWIR and TIR data. Use TIR for identifying fire-prone areas, then use VSWIR for mapping vegetation cover, clay-rich

CQ2g: How does invasive vegetation cope with fire in comparison to native species?

Hyperspectral imagery provides the means for highly accurate and very detailed mapping of vegetation type, and is thus a good way of mapping invasive species. (Dennison and Roberts, 2003)





Post-fire land cover classification for the 2003 Simi fire (Dennison et al., 2006)

- Science Issue
  Invasive species occur in many biomes together with native species. While fire affects them both, invasive species might have a different way of coping with fires than native species that have adapted to the existing fire regime.
- Tools
  Requires pre- and post-fire HyspIRI VSWIR imagery to produce accurate maps of vegetation type, in particular of invasive species. Further requires HyspIRI TIR data to detect fires in areas with both invasive and native species, and to map the fire temperature.
- Approach
  Use HyspIRI VSWIR hyperspectral imagery to accurately map vegetation type, with a particular focus on invasive species. Use HyspIRI TIR data to detect fires, map their extent, and estimate fire temperature. Use post-fire classifications of vegetation type in order to assess possible differences between invasive and native species in terms of succession and recovery.